Field Sampling Using the Rosette Sampler

LG200

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1.0 SUMMARY

The Rosette sampler is the primary sampling instrument on the *R/V Lake Guardian* for the collection of water samples for biological parameter (nutrients, phytoplankton, chlorophyll *a* and dissolved oxygen), physical parameters (temperature, total suspended solids, turbidity, specific conductance, and pH) and other parameters as needed. A part of the sampling apparatus is the multi-parameter sensor array for depth, temperature, dissolved oxygen (DO), optical transmittance, photo-synthetically active radiation, pH, electrical conductivity, chlorophyll fluorescence, and sonar distance from bottom. Along with this system, the latitude, longitude, date and time, and number of bottles fired is also recorded automatically. While all of the sensed parameters are recorded continuously, up to four of the parameters can be displayed (plotted against depth) on a computer screen as the array is deployed to the depths. Each 8-L Niskin bottle of the 12-bottle array can be closed from the deck of the vessel while the array is submerged at the various sampling depths. Besides the discreet samples collected at various depths, an "integrated sample" is collected at each station by compositing water from selected euphotic depths primarily for phytoplankton identification and enumeration.

2.0 EQUIPMENT

2.1 SeaBird Electronics 911 CTD with Rosette water sampler, sensor pump, fluorometer, transmissometer, altimeter, PAR, pH, and dissolved oxygen, with GPS interface.

Note: *To maintain the DO probe in optimum condition: 1.) Use a 1% Triton X solution to wet the membrane between casts; and 2.) Keep a 5% solution of sodium sulfite in the probe between cruises. The Triton X keeps the membrane clean and the sodium sulfite retards the consumption of the probe internal material. Dispose of waste prior to using the Rosette according to the procedures in Section 7, of "Standard Operating Procedure for Dissolved Oxygen Micro Method, Winkler Titration".*

2.2 An A-frame, 1000 feet of two-conductor steel cable, and a variable speed winch.

2.3 A stand for holding the sampling array while on deck and portable shelves to hold the sample storage bottles while filling from the Niskin bottles.

3.0 CTD OPERATION

3.1 The SeaSave Program is initiated on the Control Computer and the display is configured for the parameter ranges and the total depth expected at the present station (obtained from historical data or from a sonar reading from the bridge). The program queries for a name for the current sampling cast, along with other information for the header file.

3.2 The PAR sensor cover, the pH electrode bottle, and the hose on the sensor pump are removed.

3.3 As soon as the computer displays the depth versus temperature, altimeter, optical transmission, and fluorometer screen, the operator checks with the A-frame operator to verify that the ship is still on the station and that hydraulic pressure for the A-frame is available before operating the winch to lift the sampling array preparatory to deployment. As the array is lifted off its platform, the A-frame is rotated out from the ship by the seaman on duty so that the array can clear the ship as it is lowered into the water. The array is lowered to 1 or 2 meters below the water surface and after one minute a signal is sent via the computer to activate the pump for the DO sensor. After another minute the array is lowered to the B-1 or B-2 depth at approximately 0.5 meter per second. The near bottom sample bottle is closed and the array is elevated to the next sample depth (*If the altimeter is not working properly and the array contacts bottom as indicated by a stable depth reading while the cable is deploying, the winch is stopped and reversed so as to bring the array up 5 meters from the bottom. Three minutes is allowed for the array to drift away from the disturbed bottom sediment prior to lowering the array to the B-1 or B-2 depth and closing the near bottom sample bottle*). The array is brought up to each of the planned sampling depths and a Niskin bottle closed until all samples are collected. While the array is still submerged, the DO pump is switched off and then the array is brought up to the A-frame sheave, at which time the A-frame operator rotates the A-frame back on deck so that the array can be lowered onto its stand. The EPA Shift Supervisor and the biologist aid in deploying and retrieving the array by preventing pendulum action while the array is within reach and by directing the array onto its stand.

3.4 The Rosette operator completes the Rosette sampling data sheet, exits the SeaSave program and executes a batch program to convert the .dat file generated by the SeaBird to various human readable files and copy these files to other computers/storage devices. The operator checks these files to assure that they are intact.

3.5 The PAR sensor cover, the pH electrode bottle, and the hose on the sensor pump is replaced.

4.0 SAMPLE DEPTH SELECTION

4.1 Samples are collected at all stations at a series of depths. The exact depths are determined by the type of station (non-master or master), the season of the survey, the station depth, and the thermal profile. A generalized list of the samples collected is provided in Table 1. The "*Quality Assurance Project Plan, Great Lakes Survey Studies of Lakes Michigan, Huron, Erie, Ontario and Superior*" (QAPP), further describes the selection of the discreet sampling depths at the various stations. Prior to the survey, sample labels and other paperwork are prepared designating the sampling depths for the different stations.

Table 1. Summary of Sample Depth's Collected as part of the WQS

Spring		Summer	
Non-Master Station	**Master Station**	**Non-Master Station**	**Master Station**
SRF	SRF	SRF	SRF
MID	5 m	MEP	MEP
B-10 (excluding Lake Erie, Central and Western Basins)	10 m	MHY	LEP
B-2, only if inverse stratification is present (excluding Lake Erie)	20 m (excluding Lake Erie, Central and Western Basins)	B-10 (excluding Lake Erie)	TRM
B-1 (only Lake Erie)	30 m (excluding Lake Erie, Central and Western Basins)	B-2, only if nepheloid layer is present (excluding Lake Erie)	UHY
	40 m excluding Lake Erie, Central and Western Basins)	B-1 (only Lake Erie)	MHY (only Lake Erie, Central Basin)
	50 m		40 m (excluding Lake Erie, Central and Western Basins)
	100 m		50 m
	200 m		100 m
	B-10 (excluding Lake Erie, Central and Western Basins)		200 m
	B-2 (excluding Lake Erie)		B-10 (excluding Lake Erie, Central and Western Basins)
	B-1 (only Lake Erie)		B-2 (excluding Lake Erie)
			B-1 (only Lake Erie)

If there is a DCL, a sample is taken. If other designated samples are within 3 meters of the DCL, they are not taken.

NOTE: In addition, a separate DO survey is conducted in Lake Erie Central Basin.

4.2 Thermal Structure Abbreviations

SRF = Surface (1 m)
MEP = Mid-epilimnion
LEP = Lower epilimnion
TRM = Thermocline
DCL = Deep Chlorophyll Layer
UHY = Upper hypolimnion
MHY = Mid-hypolimnion
MID = Mid-depth
B-10 = bottom minus 10 m
B-2 = bottom minus 2 m
B-1 = bottom minus 1 m

4.3 In addition to the discreet samples, a composite (integrated) sample is prepared from the upper region of the water column. For an unstratified water column, the integrated sample is prepared

by taking equal volumes of water from SRF (1 m), 5 m, 10 m and 20 meters unless the depth is less than 20 meters. If the total depth is between 15 and 22 meters, the 20 meter sample is replaced by the bottom sample (B-1 or B-2). If the total depth is less than 15 meters, equal volumes are taken from surface, mid-depth, and bottom sample (B-1 or B-2).

For a stratified water column, equal volumes are taken from the surface, 5 m, 10 m, and lower epilimnion (LEP). If the epilimnion is very shallow, equal volumes are taken from a maximum of four sampling depths and a minimum of two sampling depths. The underlying strategy is to collect a representative sample from the epilimnion. See Appendix P for a detailed listing of sample depths for specific epilimnion depths. If the LEP sample is not easily defined by the thermal profile, the following procedure involving the knees of the EBT temperature depth trace can be used. The knees of the EBT temperature depth trace are determined by trisecting the angle between the epilimnion and mesolimnion temperature traces (upper knee) and the angle between the mesolimnion and hypolimnion temperature traces (lower knee). The upper knee is the upper ⅓ angle intercept, the lower knee is the lower ⅓ angle intercept. The lower epilimnion sample is one meter above the upper knee.

Figure 1 is an example profile that illustrates this determination.

4.4 Exceptions to this sampling scheme may occur depending upon the thermal structure at the time of sampling. These exceptions do not apply to the integrated samples. To eliminate sampling redundancy, the following specifications apply to the sampling regime:

- If an integer meter depth falls within 2 m of B-10, then the integer meter depth sample is omitted.
- If B-10 falls within 2 m of a stratification depth, the B-10 sample is omitted.
- If an integer meter depth falls within 3 m of a stratification depth, the integer meter depth sample is omitted.
- If there is a DCL, a sample is taken. If other designated samples are within 3 meters of the DCL, they are not taken.
- If the UHY sample is between 37 m and 47 m, the 40 m sample is not taken.

4.5 Sampling Strategy for Dissolved Oxygen Determination in all Five Lakes for the Summer Surveys

For the spring monitoring program when the lakes are under isothermal conditions, no samples are taken for DO analysis. During summer surveys, when the lakes are stratified, samples are collected for DO determination each master station in each lake. A full SeaBird profile is recorded for DO. In addition, a surface and B-1 sample will be collected and analyzed in duplicate by Winkler titration. Simultaneously, an oxygen-saturated sample, either from a sampled same depth or from the reagent water system, will be analyzed by Winkler titration.

An additional DO survey is conducted in the central basin of Lake Erie. Refer to Appendix D, *Sampling and Analytical Procedures for GLNPO's Open Lake Water Quality Survey of the Great Lakes*, for DO and temperature profiles for this survey.

4.6 Benthic Nepheloid Layer

The benthic nepheloid layer is defined based on the particulate levels in the water column as determined by the beam attenuation coefficient from the SeaBird downcast. A distinct difference in the coefficients near the bottom of a particular station indicates a nepheloid layer.

5.0 SAMPLE DISTRIBUTION

5.1 The operator of the SeaBird, in the control (Carolina) house, matches Niskin bottle numbers and depth identification codes on a small whiteboard which the operator places in the control house window in view of the sampling platform. This is the information needed to match cubitainer with Niskin bottle.

5.2 New pre-labeled one gallon cubitainers and brown one liter depth-coded PE bottles for chlorophyll analyses are brought to the sampling platform.

5.3 Personnel processing the samples wear clean plastic gloves to decrease the chance of contamination of the samples from oils on the hands.

5.4 Each cubitainer and chlorophyll sample bottle is rinsed with sample from the appropriate Niskin bottle prior to filling with sample. Do not inflate the cubitainers by blowing into them.

5.5 The integrated sample is prepared by rinsing the cubitainer and the phytoplankton sample storage bottle with water from any of the selected Niskins, after which the phytoplankton sample storage bottle is used to measure one liter of sample from each of the selected Niskins into the integrated sample cubitainer. The chlorophyll integrated sample storage bottle is rinsed with any of the selected Niskins, after which the integrated sample cubitainer is agitated and aliquots are transferred to the phytoplankton sample storage bottle and the chlorophyll integrated sample storage bottle.

6.0 QUALITY ASSURANCE

6.1 At each station, a high precision thermometer is immersed in the water in a Niskin bottle from the surface to verify that the SeaBird sensor is operating properly. This reading is recorded on the station visit file.

6.2 Duplicate samples are collected at sites selected according to the QAPP by closing two Niskins at the same depth, one is designated as the sample, the other as the duplicate.

6.3 Field reagent blanks selected according to the QAPP are cubitainers and chlorophyll sample bottles filled directly, after rinsing, from one of the Barnstead reagent water systems onboard.

7.0 SAFETY AND WASTE HANDLING

7.1 Refer to GLNPO's *Health, Safety and Environmental Compliance Manual* (May 1997, or as amended) and individual instrument procedural operations manuals for specific details on applicable 1) personal health and safety issues; 2) instrumental, chemical, and waste handling procedures; and 3) accident prevention. This applies to all EPA personnel, EPA contractors or federal, state, or local government agencies, and persons who operate or are passengers onboard US EPA GLNPO vessels during all activities and surveys.

7.2 All applicable safety and waste handling rules are to be followed. These include proper labeling and disposal of chemical wastes. Over-board discharges of chemical wastes are forbidden.

7.3 During sampling, caution, common sense, and good judgement should dictate appropriate safety gear to be worn in any given situation on deck. Hardhats, gloves, and steel-toed shoes must be worn in working conditions where there is a possibility of injury to the head, hands, or feet; however, if in doubt, please ask the Chemical Hygiene Officer.

7.4 Collecting samples in cold weather, especially around cold water bodies, carries the risk of hypothermia and frostbite. Sampling team members should wear adequate clothing for protection in cold weather. For specific information regarding sampling during cold conditions, please refer to the US EPA GLNPO *Standard Operating Procedures for Winter Operations* (December 1994, or as amended).

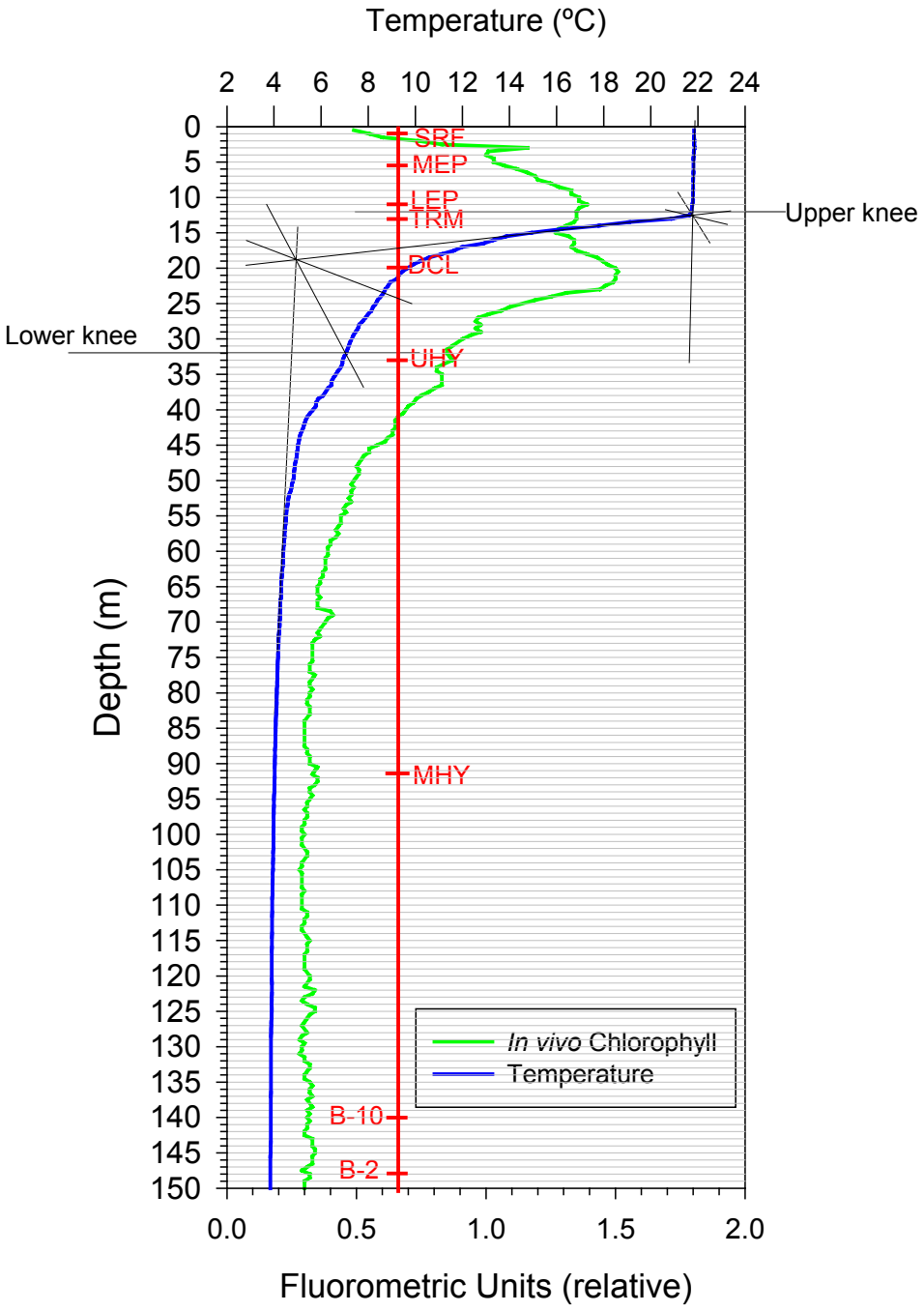
7.5 Collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Sampling team members should carry an adequate supply of water or other liquids for protection against dehydration in hot weather.

7.6 Work vests must be worn while working on the fantail and Rosette deck.

The figure shows the location of sampling depth for an unambiguous thermal profile (in this case from Lake Michigan) during the summer.

Sample	Depth
Surface (SRF)	1 m
Mid-epilimnion (MEP)	Lower epilimnion/2
Lower epilimnion (LEP)	Trisect angle formed by extending the temperature traces of the epilimnion and metalimnion. Upper 1/3 angle intercept defines the "upper knee" of the thermal profile. Lower epilimnion is defined as upper knee – 1 m
Thermocline (TRM)	Depth corresponding to greatest 1 m difference in temperature
Deep Chlorophyll Layer (DCL)	Depth corresponding to maximum in vivo chlorophyll value
Upper hypolimnion (UHY)	Trisect angle formed by extending the temperature traces of the metalimnion and hypolimnion. Lower 1/3 angle intercept defines the "lower knee" of the thermal profile. Upper hypolimnion is defined as lower knee + 1 m
Mid-hypolimnion (MHY)	Mid-point between the upper hypolimnion and the bottom
B-10	Bottom - 10 m
B-2	Bottom - 2 m

Example Temperature Profile



Example Temperature Profile